PRINCIPLES OF NERVOUS BREAKDOWN—SCHIZOKINESIS AND AUTOKINESIS

By W. Horsley Gantt
Pavlovian Laboratory, Johns Hopkins University, Baltimore, Maryland

I. Introduction

If we speak boldly of achievement in the study of the most complex structure we know in the universe, the human mind, it is with the conviction that the few steps attained, no matter how feeble they may be, are based on the scientific and objective methodology upon which has been built the great progress of science in the last century, namely, the experimental method initiated by Galileo, which has been applied with especial ingenuity to the higher nervous activity of the living organism by Pavlov.

Besides the complexity of our study of the adjustments of the human being, including his subjective life, we are confronted with another difficulty that is not shared by the other sciences today but is, almost exclusively, characteristic of our study. The difficulty I refer to is based on the subjective feelings accompanying our conscious behavior. These give us such an intimacy with every movement of our skeletal frame that we are inclined to take the representation of these mental states as equivalent to the laws revealed to us by the usual scientific analysis or, at least, to confuse the relation of the subjective feelings and the objective laws, to the serious detriment of our investigations. Another disadvantage of the appraisal on the basis of subjective feelings alone is that they, being based mainly on what is revealed to our consciousness, almost entirely neglect the strong hidden current of the autonomic visceral responses. These are either vaguely or not at all represented in consciousness. Their representations, chiefly as emotional feelings, run, moreover, in our consciousness a course that is entirely different from the course revealed by the analysis of the facts obtained through a controlled scientific methodology.

To those to whom it is not yet evident that the scientific methodology is appropriate for studying our psychical life and its distressing deviations, I hope this Monograph will provide at least a partial answer.

During our attempt to rid ourselves of the present confusion, we must remember that the subjective feelings are of prime importance. Indeed, the objective facts have absolutely no interest for us except through their connection with our subjective feelings. The recognition of the importance of the latter does not, however, warrant the substitution of traditional subjective thinking for modern scientific methodology and analysis.

In this monograph, which is devoted to the comparative conditioned neuroses in human and other animals, it would be a crass error to omit a reference to Pavlov, the discoverer of a new field of research so important for us today. More than 50 years ago, he gave a tremendous impetus to the study of phenomena that previously had been designated psychical and unsuitable for exploration by the scientific methodology. Through an accidental observation of an irregularity followed up, he ingeniously adapted a physiological method

to the investigation of behavior that was recognized subjectively but thought to have no physiological explanation. From our advanced position at the present time, it is hard for us to realize this, but we have only to recall the opinion of two notable physiologists of the period, Tigerstedt and Sherrington, who advised Pavlov to return to real physiology.[13]

Pavlov's contributions were (1) the substitution of the chronic for the acute experiment in physiology; (2) the consequent study of the whole intact animal over its life span; (3) the introduction of a method of recording the correlates of psychical reactions through objective measurements, namely, of salivary and gastric secretions. In 1922, Pavlov reported "experimental neurosis," which he had first discovered and described under another title in 1913.[6]

Today, we are conscious of the importance of action and interaction in the living organism, which we recognize in our concept of "the whole" or the total organism. The idea, of course, is not new, having been emphasized by Plato, and later by Smuts who introduced the term holism, by Meyer with his ergasias, and by others. Few realize, however, that it was Pavlov who, preeminently among modern physiologists, vigorously espoused this princple. In 1903, he said:

"In our psychical experiments there appear before us as stimulators of the salivary glands not only such properties (appearance, sound, odour, *etc.*) of the various objects which are unessential for the work of these glands, but *absolutely all the surroundings* in which these objects are presented to the dog, or the circumstances with which they are connected in real life. For example, the dish in which it is presented, the furniture upon which it is placed, the room, the person accustomed to bring it, and the noises produced by him—his voice, and even the sound of his feet—though at the moment he cannot be seen."[13]

In this reference to Pavlov, it is hardly necessary to mention that, like every other scientist who bases his theories on his discovered facts, he made errors that have to be corrected by those who cultivate the same field. The comment of Voltaire on Descartes could be applied to Pavlov:

"And if he was mistaken in some things, the reason of that is, a man who discovers a new tract of land cannot at once know all the properties of the soil. Those who come after him, and made these lands fruitful, are at least obliged to him for the discovery. I will not deny but that there are innumerable errors in the rest of Descartes' works . . . However, it will not be making him too great a compliment if we affirm that he was valuable even in his mistakes. He deceived himself, but then it was at least in a methodical way. He destroyed all the absurd chimeras with which youth had been infatuated for two thousand years . . ."[20]

Referring to Descartes and Newton, Voltaire added: "The man who first brought us to the path of truth, was perhaps as great a genius as he who afterwards conducted us through it. Descartes gave sight to the blind. The path he struck out is since become boundless."[20]

With the complexities of the human brain as with the physical science of Descartes's era, we may exclaim that "in fathoming this abyss no bottom has been found," but at least a beginning has been made.

II. Extension of the Field

Although Pavlov began his conditional reflex experiments with an observation of the autonomic system, medicine and physiology have, in general, not recognized that the unconscious "involuntary" processes are subject to modification, through experience, just as are our unconscious "voluntary" movements. Psychiatry, on the other hand, makes full recognition of the modifiability of practically all living processes, but psychiatry has been too lax, as have some of the Russian successors of Pavlov, in not requiring the usual scientific evidence to prove inclusion of the autonomic reactions. My experiments in the laboratory show that there are specific laws that govern whether or not any physiological response is capable of becoming conditioned, and that it is as erroneous to assume that any inborn response can be conditioned as it is to deny to the autonomic responses the modifiability-by-individual-experience principle.

Bykov, one of the main followers of Pavlov in Russia, has shown the interaction of the nervous system with the kidneys, the liver, the cardiorespiratory system, the gastrointestinal tract, the metabolism, the thermal regulation, and the individual tissue processes through individually acquired conditional reflex connections. In the present paper, it is not possible to describe the work in each of these fields, but the investigation of the conditional reflex connections of the kidneys may be mentioned as an example. Although the mechanism of renal secretion has been studied exhaustively with respect to composition of the blood, blood pressure, and water intake, its relation to the higher nervous processes has not been determined, in spite of its dependence upon nervous control. Dogs with externalized ureteral orifices were kept on a constant diet and observed for a number of years. Spontaneous secretion varied with either excitatory or inhibitory nerve processes, for example, as caused by the presence of the investigator. Owing to the action of such extraneous agents, exclusion in a Pavlovian camera was essential. Bykov states:

"The method of the chronic experiment demands that the investigator should be specially trained as it greatly differs from the acute experiment in which the investigator considers only one aspect of the process and is isolating a complex phenomenon. With the chronic experiment the complex process is observed as it runs its natural physiological course."[8]

Together with my collaborators (Hoffmann, Dworkin, Robinson, Otterback, Teitelbaum, Mackenzie, Peters, Fleck, Gakenheimer, Owens, Traugott, Reese, Dykman, Stephens), I have made a special study of the changes in heart rate accompanying the whole process of conditioning and adaptation. It has been known, of course, that the heart participates widely in a variety of psychical and somatic events, but there has been practically no systematic investigation of the cardiac changes under the rigidly controlled conditions of the conditional reflex experiment. Hoffmann and I first established that there are definite and specific changes in heart rate (HR) during the excitatory and inhibitory conditional reflex.[3] Robinson and Gantt, investigating the orienting reflex (questioning response), found in dogs that the intensity of the motor components and the amplitude of heart rate changes were parallel.[17] The heart rate changes

are precisely adapted to the whole procedure, to the intensity of both the conditional and unconditional stimuli,[6] and even to the time intervals between the signals.[10] In human beings, the psychogalvanic reflex is generally parallel, to the motor components of the orienting reflex, and specifically related to the excitatory and the inhibitory motor conditional reflexes.[16]

Whitehorn (in patients) and Hoffmann and Gantt (in dogs) have shown independently that the heart rate is not always parallel to the movements of skeletal muscles, *i.e.*, to the external expression. Thus, when a spontaneous movement is made, it is preceded rather than followed by an acceleration of heart rate. The nature of the spontaneous movements, for example, whether the dog changes from sitting to standing or *vice versa* or whether he merely shifts his weight is immaterial. First, there is the cardiac acceleration and then the movement or, as Hoffman has put it, "first comes the heart rate and then the dog." From these observations of normal behavior, it appears that some natural excitation in the central nervous system, expressed by an increase in heart rate, not only results in, but rapidly expends itself in, muscular movement. The confirmation of such an explanation has been achieved partially in the experiments of Peters in the human, but its full vindication must await further detailed experiments.[15]

Finally, the comparative physiology of the cardiac, secretory, and motor conditional reflexes reveals what may be a basic constitutional mechanism for nervous dysfunction on the higher level of behavior. Our studies show that the cardiac component is formed more quickly than the motor component of the conditional reflex to pain, and that the cardiac component persists much longer.

The cardiac component is both more sensitive, since it appears first, and, paradoxically, more stable, since it persists longer. Without reinforcement, it has endured as long as two years after the motor component has dropped out. If the cardiac acceleration represents the inner emotional aspect, and the motor conditional reflex the specific external component, we have the picture of an organism externally in adaptation to the environment, but internally excited and reacting to the trace of a conditional stimulus that long since has ceased to have its former significance (FIGURE 8).

All dogs do not show the differences in speed of formation and in retention between the cardiac and motor components of the conditional reflex.[1]

III. Types

The enormous differences between individual dogs in the formation of the conditional reflexes are even more impressive than is the appearance of the experimental neurosis. These differences have to do with speed of formation, relation of excitation to inhibition, stability of the excitatory and inhibitory conditional reflexes, amplitude of the autonomic responses, as well as with susceptibility to the special deviation of behavior that we call the experimental neurosis.

Pavlov described four types ("temperaments") in his dogs: two extreme pathological types, the choleric and the melancholic; and a central equilibrated type, which was subdivided into the sanguine and the phlegmatic. He says:

"If one accepts the old grouping of four temperaments then one cannot fail to see its analogy to our experimental results in dogs. Our excitatory type is the choleric; and our inhibitory is the melancholic. The two forms of the central type correspond to the phlegmatic and the sanguine temperaments. The melancholic temperament is evidently an inhibitory type of nervous system. To the melancholic, every event of life becomes an inhibitory agent; he believes in nothing, hopes for nothing, in everything he sees only the dark side, and from everything he expects only grievances. The choleric is the pugnacious type, passionate, easily and quickly irritated. But in the golden middle group stand the phlegmatic and sanguine temperaments, well equilibrated and therefore healthy, stable, and real living nervous types no matter how different or contrasted the representatives of these types may seem outwardly.

"The *phlegmatic* is self-contained and quiet,—a persistent and steadfast toiler in life. The sanguine is energetic and very productive, but only when his work is interesting, *i.e.*, if there is a constant stimulus. When he has not such a task he becomes bored and slothful, exactly as seen in our sanguine dogs, as we are accustomed to call them. Such animals are extremely lively and active as long as the surroundings stimulate them, but they begin to doze and sleep when they are not stimulated."

At other times, he spoke of a strong and a weak dog.[14] People, he divided into two general categories, artists and thinkers, with a middle group, represented by the average person:

"The artists, including all types, as writers, musicians, painters, actors, *etc.*, comprehend reality as a whole, as a continuity, a complete living reality, without any divisions, without any separations. The other group, the thinkers, pull it apart, kill it, so to speak, making out of it a temporary skeleton and then only gradually putting it together anew, piecemeal, and thus try to give it life in order that they might also succeed. This difference is especially prominent in the so-called eidetic imagery of children. Here I remember an astonishing case that occurred forty to fifty years ago. In a certain family with an artistic leaning there was a child two or three years old whose parents among other things diverted him and also themselves by giving him to pick over a collection of twenty or thirty photographs of their relatives, writers, artists, *etc.*, naming each one to him. The result was that he called them all correctly. What a general amazement there was when accidentally he also named them correctly, taking them in his hand from the nurse. Evidently in this case the cerebral hemispheres receive the visual stimuli exactly as the variations of intensity of the light in a photographic plate, just as a phonographic record is made from sound. Indeed this is, some may think, a characteristic of all types of artists. Such a whole creation of reality cannot be completely attained by a thinker. This is why it is so exceedingly rare that there is united in one person a great artist and a great thinker, [as there was in Leonardo da Vinci and in Goethe]."[14]

It is important to emphasize that, in my experience, casual observation of the animal does not reveal nor give us the basis to predict susceptibility to breakdown. It is only by the detailed, controlled laboratory experiment that

we have been able to predict (and then only to a limited degree) which animals will break under a certain psychical load.[5]

FIGURES 1 and 2 show the comparison between two dogs (Connie and Draft) in speed of formation of the conditional reflex, measured by their ability to differentiate between an excitatory signal for a faradic shock to the foot and an inhibitory signal. From casual observation, it was not possible to predict

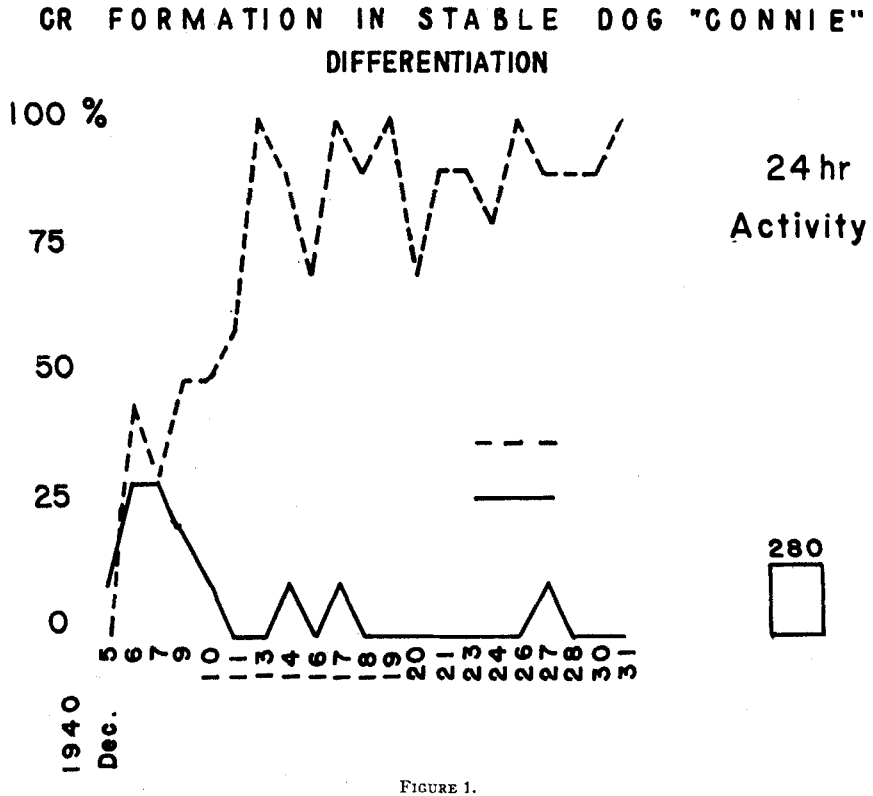

FIGURE 1.

the changes revealed by special laboratory work. Connie, as can be seen in the chart, not only forms the conditional reflexes more quickly, but also differentiates quickly and soon reaches stability in the conditional reflexes (frequency, latent period, amplitude, *etc.*).

If we study the respiration of these two dogs, we also see marked differences (FIGURES 3 and 4). Connie's respiration is quiet and shows little disturbance even before differentiation has been attained. Draft, on the other hand, shows marked disturbances in respiration, especially to the undifferentiated signal. The respiration becomes less disturbed, however, as the dog differentiates (FIGURE 5).

Turning to a study of the heart rate, we see changes similar to those in the respiration (FIGURE 6). In both dogs, there is a greater increase before differentiation become established than there is later, when differentiation is achieved

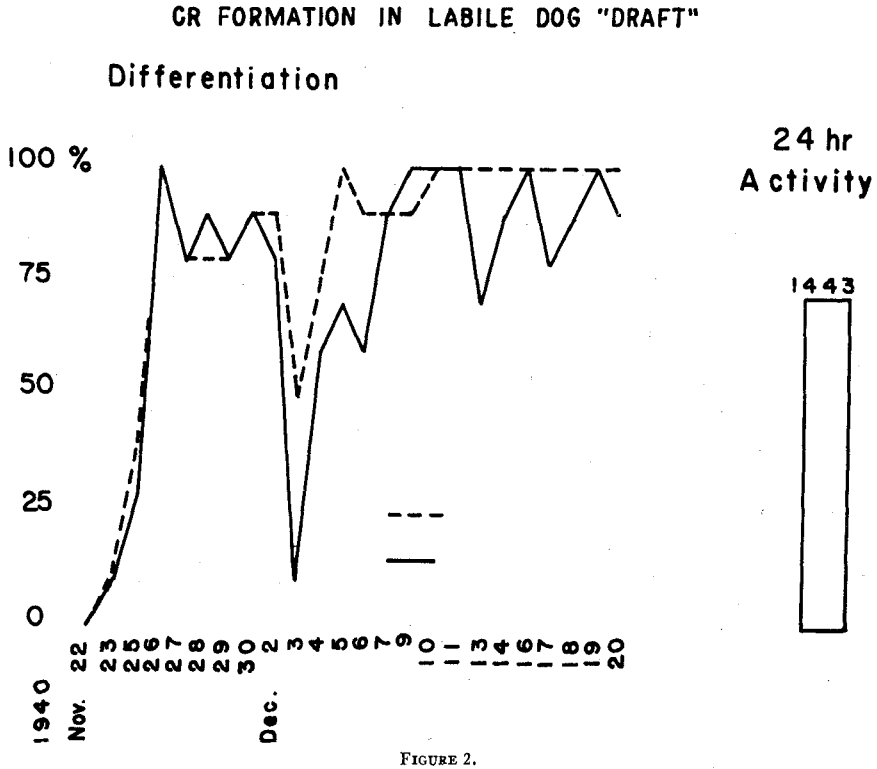

FIGURE 2.

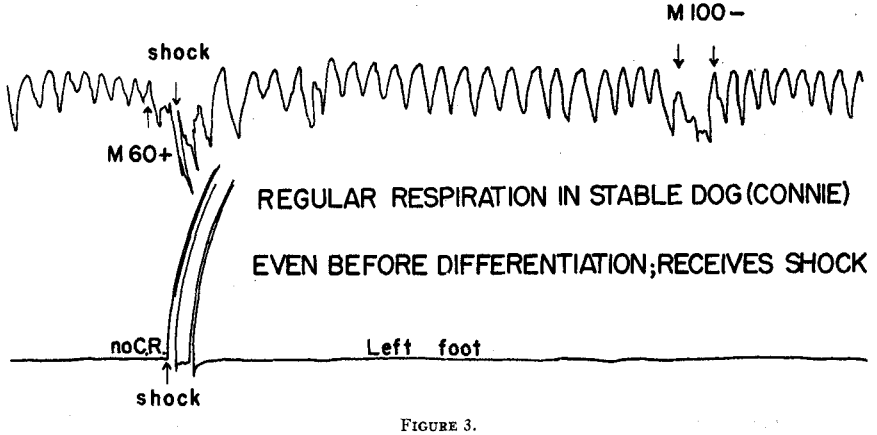

FIGURE 3.

(FIGURE 7), but the heart rate is increased not nearly so greatly to the conditional signals in Connie as it is in Draft. Throughout his life, Connie remained a stable well-balanced dog, while Draft was always excitable and never made stable differentiations.

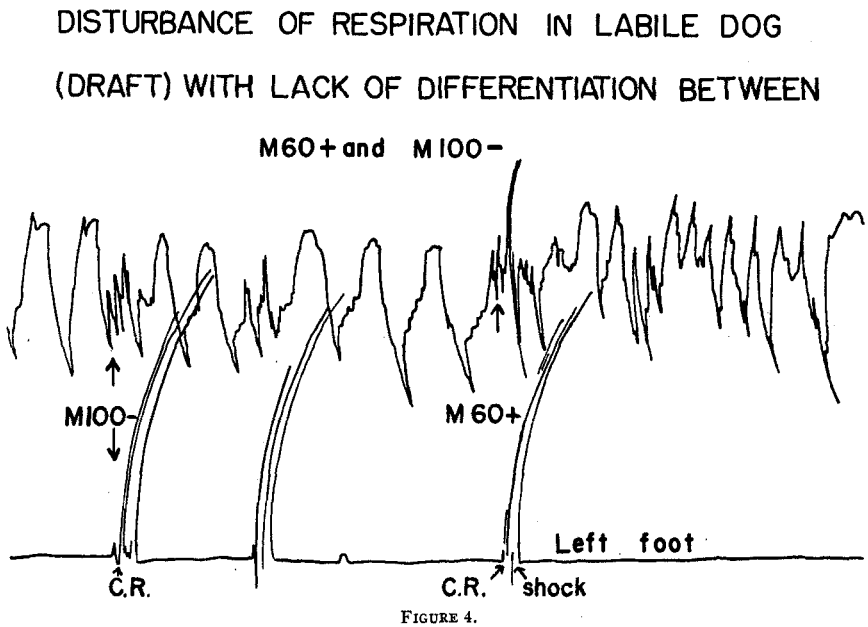

FIGURE 4.

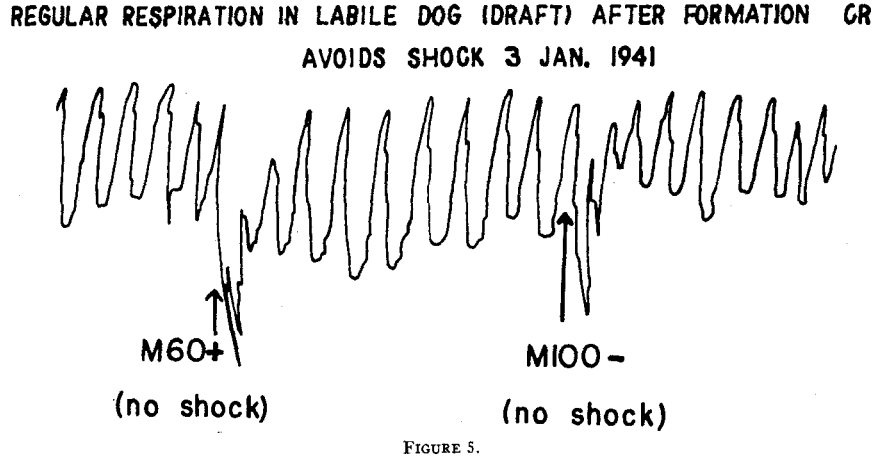

FIGURE 5.

IV. Description of Two Neurotic Dogs

Two examples of the most persistent experimental neurosis seen in the laboratory during its 22 years appeared in "Nick," studied from 1932 to 1945,

and in "V3," studied since his birth in the laboratory in 1947 to the present. These two dogs were of opposite types, and gave almost completely opposite symptoms.

Nick was a mongrel brought into the laboratory at about one year of age. He showed no remarkable symptoms on casual observation. V3, part French poodle, born and reared in the laboratory, was shy and unfriendly from the

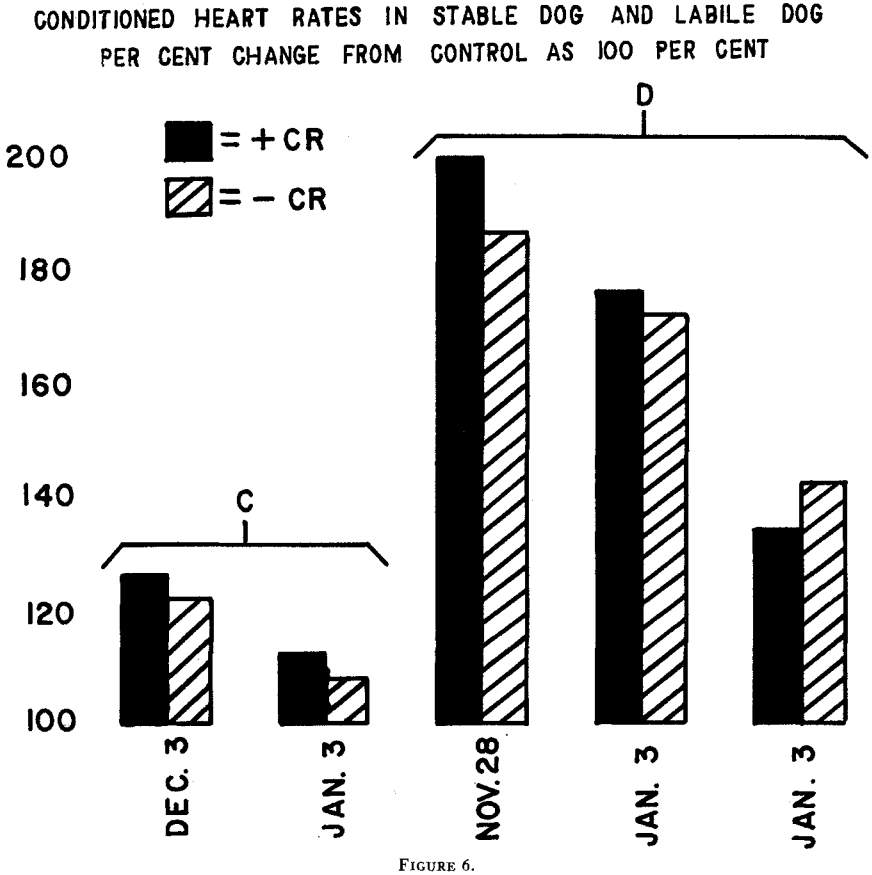

FIGURE 6.

very first, running away from everyone as if frightened. Nick would take food from the hand of the people in the laboratory, while V3 would ignore food until no one was present.

Nick began to show disturbed behavior during the first month of experimentation, and he became worse during the next two years of continued active experimentation. The symptoms in this period were excitable behavior (running violently in and out of the experimental room, barking, panting, refusing to eat, negativism).*

* For detailed description of this dog see Reference 6.

During 1932–1933, Nick was subjected to the daily conflict in the experimental room and he became very restless, panicky, and agitated, but he did not exhibit the prominent symptoms (respiratory, urinary, and sexual) until one or two years after experimentation was discontinued. His worst symptoms

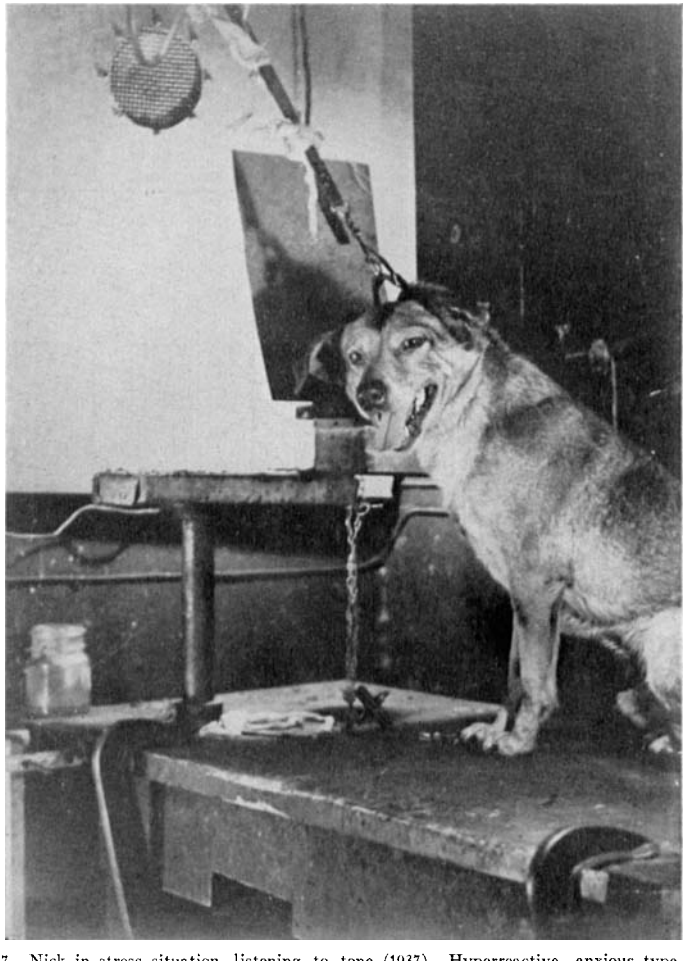

FIGURE 7. Nick in stress situation, listening to tone (1937). Hyperreactive, anxious type. Note dog pulling away from tone, anxious breathing, sexual erection.

arose in 1935, during rest and two years *after* experimentation. Overwhelming evidence of the relation of these late symptoms to the original conflict were brought out by appropriate experiments.[6]

The life-long study of this dog, not only during acute breakdown but also afterwards while resting, afforded us the means of seeing the origin of symptoms in the interval when nothing was done to the dog.

V3 was born in 1947 and reared in the laboratory. His sire and dam were

siblings. He never received any special attention until 1949, when Dr. Fleck and then Dr. Arthur Humphries started work with him. This work consisted only in getting acquainted with the dog and making general observations, with occasional attachment of apparatus. V3 was fastened in the dog stand only a few times. Once, while in the stand, he had a convulsion, falling down and showing such markedly abnormal behavior that Humphries, then a medical student, called me to see the dog. After about three months of observation, which the dog received no maltreatment at our hands, except for the restriction in the stand and, occasionally, attachment of apparatus, V3 was given a rest.

In October, 1950, Dr. Youssef Mawardi and I began to study the effect of

FIGURE 8. V3 in stress situation (1950). Catatonic type. Note absence of panting, tucked tail, sexual erection only after alcohol.

alcohol on sexual reflexes in V3. This dog was of especial interest because of his failure to give any sexual erection to peripheral stimulation, except when under the influence of alcohol (FIGURE 8).

From November, 1950, to May, 1951, V3 was observed by Dr. Mawardi and me, especially for the study of his sexual reflexes under alcohol. During all this time, he remained extremely shy, running away from all the laboratory personnel.

Although V3 gave no sexual reflexes before he had alcohol, under the influence of 2 cc. alcohol per kg. body weight, he had a spontaneous erection when he was brought near the camera where previously he had received peripheral genital stimulation and, on one occasion, the erection, which was partial and without ejaculation or orgasm, lasted an unusually long time, 37 minutes. This dose is large enough to inhibit sexual erection in normal dogs but, in this

extremely pathological animal, the most persistently neurotic of any dog we have had, erections appeared for the first time.

Alcohol was given to V3 several times in November and December, 1951. Its effects included the disappearance of his shy frightened attitude, less running away from people and, for the first time in this dog's life, the appearance of sexual erections both to peripheral stimulation and as a conditional reflex when he was brought into the camera where peripheral stimulation previously had been used but had failed to produce the sexual erections. On several

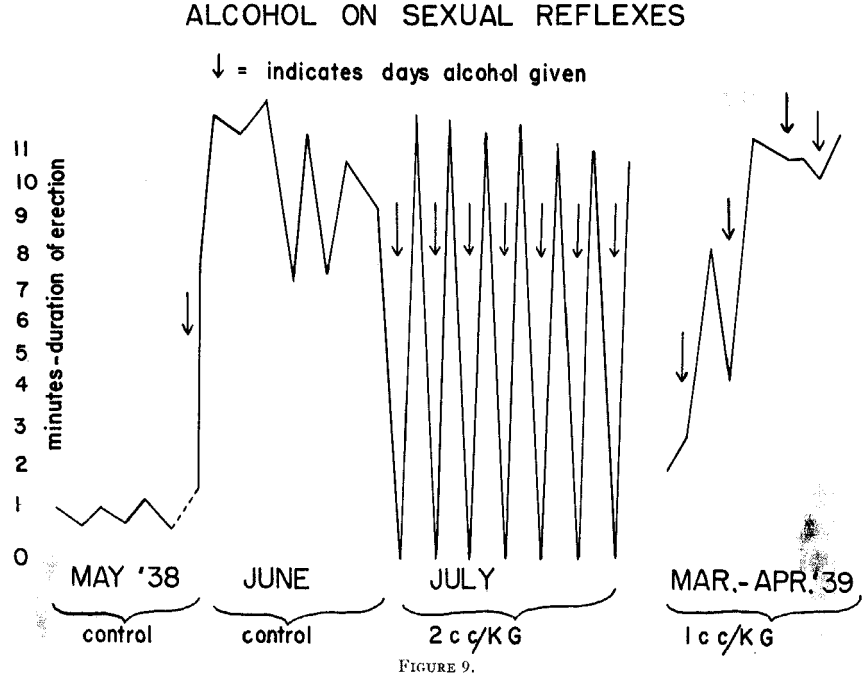

FIGURE 9.

occasions, V3 showed not only the erection but also orgasm and ejaculation under the influence of alcohol (FIGURE 9).

The striking thing in this dog is that, after administration of alcohol, although no alcohol was administered on the day of observation, sexual erections were obtained even when V3 was merely brought into the camera. This is an example of the therapeutic effect obtained under drug action, which continued even though the drug was not present. Internal development has occurred in the animal without present stimulation from the external environment (*autokinesis*). A similar observation of autokinesis was seen in Nick. Alcohol in large doses inhibited his sexual erections but, on the days that alcohol was not used, Nick showed markedly increased sexual erections, apparently as a result of alcohol (FIGURE 10).

The improvement in V3 was not permanent, however. He was allowed to rest from April, 1951, until February, 1952, since which time he has been under

weekly observation by the author. No form of therapy or alcohol has been given since early 1951, but he has been taken from his paddock into the experimental camera about once a week for observation. His behavior has become stereotyped, showing many interesting features reminding one of compulsions, echopraxia, panic, and catatonic behavior with catalepsy. When observed in the paddock from a distance of a few yards, V3 appeared quiet and undisturbed, frequently lying down or peering through his window at the passers-by. As soon as one would approach the door to his paddock, however, he would run around in circles and retreat to the back with his tail tucked. When his door was opened, he would immediately rush out past the experimenter, stand a few moments in a far corner of the paddock corridor and then, after a minute or so, dash past the experimenter in a wild frightened way and, if the door of the experimental room was open, run into it and stand there motionless, awaiting the experimenter. It was not possible, at this point, to induce the dog to go back into his paddock, unless the experimenter went into the experimental room where the dog was, closed the door, sat by the dog for at least one minute, and then opened the door, at which point V3 again would rush past the experimenter, back to his paddock if the paddock door was open or, if it was closed, he would wait in front of it. This behavior became so stereotyped that, in order to get the dog back into his paddock when he ran out accidentally, it was necessary to let him go into the experimental room, close the door, then reopen it, after which the dog would return to his paddock.

Inside the experimental room, V3 shows extraordinary abnormal behavior, suggesting catalepsy, and opposite in character to his frightened hypermanic flight before he got into the experimental room and after he left it. The routine behavior in the experimental camera was the assumption of a fixed immobile posture near the center of the camera and flexibilitas cerea of the limbs, so that one forepaw, when flexed under his body, was held up for a few seconds to several minutes, the dog standing on three legs. His legs could be widely abducted to their full length, which position was held for several minutes, until V3 sank gradually to the floor. Hypodermic needles could be inserted subcutaneously over many parts of the body without reaction (although not in the most sensitive places as on the face or in the groins). V3 was nonreactive in his movements to loud startling stimuli, such as banging on the shelf near his head or loud clapping of the hands within a few inches of his ears, although he would give the orienting reflex (questioning) response (OR) to a very small stimulus, such as the faint scratching of a needle on a board.

This nonreactivity in the OR to loud stimuli, but reactivity to faint ones, has been described by Pavlov under the term of "hypnotic phases" (paradoxical phase). Pavlov also described motor immobility ("status marmoratus") in certain neurotic dogs. One of such dogs that I saw in his laboratory stood perfectly stiff and motionless without turning toward the proffered food, while saliva flowed copiously.

V3 often urinated as soon as he entered the camera and, occasionally, defecated and vomited there. These reactions appeared especially when only strangers were present with him in the camera.

V3 in the camera has been described for me by two competent, though

differently trained observers, a scientist and a writer. Dr. George Sutherland described him as follows on May 24, 1952:

"12:50. Dog came out of room or cage readily enough but hesitated to pass by me (there were also two strange cats in the room with me)—finally with a shove he ran by into the laboratory—when I followed along with Dr. Gantt. He had assumed an awkward semi-crouching position and appeared to be staring vacantly. He remained in this position roughly 5 minutes during which time Dr. Gantt changed the position of his right front and back leg. He made no visible effort to resist the passive molding of the limbs. Very slight response to loud clapping of hand; or being pricked with a hypodermic needle. He would half-orient to mild scratching sounds but not to Dr. Gantt's voice or to mine.

"When Dr. Gantt left the room I prevented the dog from leaving also which he made a rather feeble effort to do. In the room with me at first he was restless but after about 1 minute became almost immobile—I could hear Dr. Gantt moving outside the door from time to time. The animal oriented himself toward the source of this sound giving a start at each new sound. After 2 minutes he began to "heave" and finally vomited his food [vomitus apparently was fresh, undigested meat, practically no gastric juice, about 400 gm. well chewed meat] and became passive once more. After 3 minutes I opened the door and he dashed out and appeared to make for Dr. Gantt."

Dos Passos, who saw the dog five days later, wrote from memory on the next day:

"The dog had the drooping dejected look of a dog that has just been given a beating. Showed no sign of pleasure at being spoken to. When the door was opened he ran apprehensively out of his cage into the hall, and then ran up and down, nose down, tail limp as if trying to run away. The dog made no effort to escape up the steps into the corridor from which we had come as a normal dog probably would trying to escape. When the door to the little closet where experiments had been conducted [camera] was opened the dog dashed in. We found him motionless standing under a shelf in the back of the closet with his head a little to one side. When Dr. Gantt lifted the paw of one leg the leg remained in the position he put it in, with the paw twisted up. The dog showed no reaction to pricks with a hypodermic needle or to loud clapping of the hands, though he seemed to notice a slight scratching on the woodwork.

"I don't quite remember how the dog came to leave his frozen position. Once out in the hall he resumed his aimless anxious running up and down."

V. Schizokinesis and Autokinesis

A decade ago, when I was writing up the results of ten years' experimentation with the neurotic dog Nick,[6] no general formulation of the principles underlying the experimental neurosis was apparent to me. For this reason, I welcomed the analyses of the factors in the breakdown of Nick by three psychiatrists (Saul, Leighton, Ischlondsky) eminently fitted for the task. I acknowledge, of course, the importance of the principle of conflict between excitations of

opposite nature emphasized by Pavlov, but there are other responsible forces involved: for example, Pavlov's temperaments, Liddell's idea of the restriction of the experimental setup, the concept of interpersonal relations (Sullivan, Whitehorn, *et al.*).

With the continued study of various aspects of the responses of dogs and, to a lesser extent, of the human being, in the last ten years, certain general principles have appeared to me to be the basis of nervous breakdown. These principles were not previously apparent. Rather than having to do with external events, they are primarily inherent in the structure and function of the living organism. In general, they are of opposite nature. The first principle is a failure of the organism to work harmoniously. It involves a basic discrepancy between the more external expressive movements (which, being in our consciousness, appear to us usually as voluntary and purposeful) and the generally hidden visceral responses, which are ordinarily out of consciousness. Harmony and teleology no longer rule here, and the organism seems to be impelled by a *vis a tergo* to act in a certain way, regardless of whether or not this is detrimental. This is one basis for psychopathology.

The idea of law and order in biology, the relation of function to structure, is, of course, not new, having been emphasized in the 19th century by Huxley, William James, and others. Indeed, the firm though misplaced belief of a previous generation that all mental life could be reduced to physical laws such as hold in chemistry and physics may have been responsible for the present reaction and resulting confusion and lack of clear thinking that exist in some circles today. There was, without doubt, a need to recognize the complexity and special properties of living structures, which are not adequately revealed by the physics and chemistry of the inorganic world. Thus, to many of our present generation, it has seemed less naïve and more comprehensible to speak in terms (even though clothed in sophisticated Greek and Latin names) more nearly descriptive of our subjective representations, of our usual feelings about order, harmony, and purposeful action, than to look to the scientific method for an explanation.

In my early laboratory work, I fell into the same ambivalent confusion of using what appeared to me then as the appropriate teleology to explain biological function. Time and again, however, the predictions based on such reasonings failed to concur with the facts of the experiments, and I have had to abandon the traditional subjective explanation for a formulation of law based on facts revealed by objective experiments that would give approximately the same answer to all investigators.

From a comparison of the cardiac responses with the motor and salivary CR's, it has become more evident that laws revealed by experiments come nearer to showing the relations between biological events and to giving us a basis for prediction than do our feelings as to what is the appropriate way for the organism to act.* The cleavage between the emotional, visceral, and superficial motor responses I first referred to as *dysfunction* but, later, I have substituted the term *schizokinesis* as being more specific.

* I am indebted to Dr. David Rioch for first calling the importance of the comparison of the cardiac and motor CR's to my attention in 1944.

The second principle, which can be at the basis of either pathology or therapy, became apparent to me in the study of (1) normal retention and "spontaneous restoration" of extinguished conditional reflexes; and (2) the development of neurotic symptoms in dogs several or many years after the animal had been removed from the traumatic situation—symptoms, however, definitely related to the original conflict, which had developed its trace in the nervous system. Thus, there appeared to be a function of "spontaneity," *i.e.*, of inner development, on the basis of structure and individual experiences, the development occurring not during the external stimulations, but years after their discontinuance. This function I now call *autokinesis.**

VI. Disharmony and Disorganization

From the time of the Greeks through the Scholastics, harmony as a quality of the universe has been emphasized. The harmony of the individual to his environment has been expressed more recently by the science philosophers, such as Darwin, with his adaptation to environment; and Pavlov, with his equilibrium to external forces through positive and negative conditional reflexes. More recently, we have such views expressed as homeostasis, the organism fulfilling its needs, as has been demonstrated by Richter in the selective diet of rats and particularly emphasized by Masserman in the use of alcohol in neurotic animals.

Although there is no doubt of this ability of the organism to adapt to the environment, it has perhaps been overemphasized at the expense of another equally important trend—that leading toward disharmony and disorganization. This second trend arises on the basis of the first, by virtue of the tendency of the organism to obey laws. The obedience to law and action through mechanisms determined by laws, as well as chance reactions, often brings the organism out of adjustment and into chaos. I shall now emphasize this second trend.

Pavlov Adaptation. Pavlov has shown, through synthesis and analysis, how the organism tends to preserve an equilibrium with its environment through the positive and negative conditional reflexes. This process imposes a burden on the nervous system, in the sense that it involves tension and stress. The adaptation is more of a compromise, especially on higher levels, than a perfect equilibrium.

Although a neurosis (*i.e.*, imperfect adaptation) is natural in the higher animals in the same sense that death is natural, it cannot be considered as a perfect adaptation.

Cardiac Conditional Reflexes. Change in heart rate has been known for a long time as a component of emotion. We have recently shown that there is a definite change in HR not only to neutral stimuli but to (1) the kind of sensory stimulus used; (2) whether the process is excitatory or inhibitory; (3) the intensity of the unconditional stimulus, *i.e.*, the degree of motivation; and

* In 1949, after many discussions, *schizokinesis* was suggested to me by my collaborator John E. Peters as an appropriate term for this split function. The word *autokinesis* had its *accouchement* with my friend John Dos Passos. While swimming in the Potomac in July, 1952, after we had discussed, on the previous day, the idea of an inner development on the traces of old experiences and my objections to the word spontaneity, he came up from under a wave with, "What would you think about autokinesis for the thing you have been talking about?" Here was an example of an elaboration on the basis of the previous day's stimulation—of autokinesis.

(4) the state of the organism (satiation, *etc.*). In these adaptations, we find the explanation simpler by a reference to laws, *i.e.*, relations between events, than by the fulfillment of a need.

Origin of Maladaptation. A comparison of the change in HR accompanying (1) muscular movements of the dog; (2) the UR or the eating of the food; and (3) strong emotional states, such as sexual excitation and copulation, show that the HR accompanying a signal for a morsel of food (one or two grams) is markedly greater than that produced by moderate muscular movements and comparable to those accompanying violent emotions. The cardiac CR is, hence, out of all proportion to the needs of the organism or to the requirements of the present task. Such a violent change in HR is necessarily accompanied by other marked alterations (metabolic, endocrine, *etc.*). It is true that such an excessive reaction may perhaps have some phylogenetic basis. The signal for food in a predatory animal certainly has to mobilize energy with extreme rapidity and prepare the animal for an attack. Likewise, animals other than the carnivora must be quickly prepared by signals for flight or fight.

Split Function: Schizokinesis. Here we have a basis for a conflict. Through the medium of adaptation, *i.e.*, the conditional reflexes, the organism is reacting in a way that is directly opposed to its success. This is the initial basis of maladaptation, *i.e.*, the dependence upon mechanisms.

We shall next examine what happens during the process of subsequent adaptation, particularly with that most important organ, the heart. We know that adaptation of the conditioned salivary secretion can be made through the process of extinction. The cardiac conditional reflex, however, is much more difficult to extinguish, as can be shown in both the acute and chronic experiment. Thus, if we repeat a stimulus without reinforcement, the secretory and motor components drop out, but the cardiac conditional reflex persists much longer. Likewise, if the dog is getting a long period of rest, in one case 15 months, the cardiac conditional reflexes persist while the secretory and motor may not. The dog remembers with his heart (emotionally), but not with the specific movements. Thus, the emotional basis for action remains after the external and superficial movements of adaptation have been lost. The persistence of the visceral conditional reflex is phylogenetically related to the older subcortical reactions, which, as we know, are less modifiable by experience.

Consequences. As a result of these two characteristics of the cardiac conditional reflex, namely, (1) an increase out of proportion to the needs of the organism, and (2) its persistence after the more superficial conditional reflexes (motor and secretory) have been extinguished, we have an example of a visceral function being out of harmony with the environment, and thus creating a focus of disturbance. The organism is being pounded by past emotional memories, which prepare it for an act no longer required.

Secondly, the production of a strong emotional state consists not only in a marked increase in HR, but also in a train of other internal events, such as endocrine secretions, (*e.g.*, of adrenalin), which are not followed by an appropriate activity to consume these emotional substances. The question arises whether or not their presence in the blood has a detrimental effect when they are not disposed of by external activity.

Besides this physiological hypothesis, a psychological explanation might be given. Pavlov showed that disturbed behavior arose from the juxtaposition of excitation and inhibition, and he hypothecated that there was a clash in the cortex between substances responsible for these two states. This is an interesting theory that awaits experimental verification. From the considerations I have presented, it seems that conflict is not only determined by the accidental clashes of excitation and inhibition in the environment but by a natural tendency within the organism to act according to certain mechanisms, regardless of whether or not these are appropriate. The existence of this tendency does not negate the ability of the organism to react according to certain needs* and for its own preservation.† The lack of omniscience and omnipotence in the nervous system makes it an opportunist dependent upon mechanisms that are not always perfect. The organism is constantly at war, not only with its environment but also with its own means of reactivity to its environment. The very function of symbolization responsible for our marvelous ability to adapt is also the function at the basis of disturbed behavior. Due to the characteristics of excess reaction to symbols, and the property of split function, there is a greater retention of the visceral components than of the more external motor and secretory ones. That the organism may be superficially at rest but violently disturbed internally has a physiological basis as well as a Freudian one. There are physical organs (*e.g.*, the vermiform appendix) as well as physiological functions that serve no useful purpose, and remind us that neither nature nor man has yet created a perfect world.

A comparative study of the emotional components of the conditional reflex reveals that there is a fundamental basis for conflict, a real psycho-dysfunction. This schizokinesis has its basis not so much in a situation strange to the animal as in mechanisms inherently maladjusted to the needs of the individual. In summary, these are:

(1) The excessive emotional responses that underlie nearly all new adaptations through the conditional reflex. This is revealed in the accelerated heart beat, respiration, *etc.*

(2) The retention of the conditional reflexes long beyond the point that they are useful. The organism becomes like a museum of antiques.

(3) After adaptation by extinction of the learned responses, with the passage of time, the conditional reflexes revert to a former state of either excitation or inhibition, depending on certain former relationships and without reference to present needs.

(4) Under conditions of stress, inversion of the conditional reflexes occurs, so that the large ones become small and the small ones large—perverted reactions during a crisis.

(5) After childhood, there is a greater tendency for the retention of the older conditional reflexes with the exclusion of the formation of new ones—lack of adaptability to the present environment. This reaches its acme in the Korsakov psychosis.

* To use the word "need" in any science, except as an unequivocal physical requirement for maintenance of life (*e.g.*, oxygen, food, water), requires great wisdom lest it degenerate into a cliché reflecting only the authoritative interpretation of the user.

† Structure determines function and, *vice versa*, function modifies structure. How, we do not know.

(6) The existence of the motor conditional reflexes in the human being has been shown by Bykov to require a larger oxygen consumption, *i.e.*, to be less efficient in performing a given work than if that work is done without the preliminary conditional reflex. If the given task is preceded by a bell as the signal for the task, the amount of oxygen consumed during the actual execution of the task (exclusive of the bell) is greater than when it is not preceded by the bell. Thus, the very existence of the conditional reflex, although perhaps useful under certain circumstances, may be wasteful of energy and costly to the organism. This is the case, for example, with cardiovascular disease, where the heart is operating close to its limit.

(7) The study of the emotional components shows that they persist for years after the environment has changed, even when the specific components have been extinguished. Thus, the heart will continue to beat faster to a bell that used to be a signal for food even though it no longer signalizes food, and even though the appropriate secretions and movements have dropped out.

(8) We do not inherit specific acquired responses but, through heredity, we have the mechanisms for forming individual reactions. When these reactions function in a perverse way, the explanation is usually that such a mechanism was essential during some former biological era, perhaps thousands of years ago. A basic mechanism that cannot be modified in response to needs during the life of the individual is clearly a maladaptation. The cleavage between the emotional and specific responses (schizokinesis) is such a psychodysfunction.

These considerations are enough to show that the organism operates by laws, and that these laws do not always favor the health and life of the individual. As the organism is constituted, however, the ability to elicit an inefficient (from the mechanistic point of view) emotional response is often characteristic of the difference between the normal and the psychotic person, as Whitehorn has pointed out.

Autokinesis. Two series of facts observed in this laboratory over the last twenty years have brought me to recognize the importance of the development that goes on within the central nervous system of the individual without the benefit of external stimulation, but on the basis of old excitations. We already know of the powerful force toward development within the individual, the force that makes of the acorn an oak, of the tiny fertilized ovum a complex adult. But while we recognize the existence of the ontogenetic development in embryology because it is so obvious, some of the other potential forces in the development of behavior remain hidden from us because of their complexity.

The series of facts I refer to are (1) spontaneous restoration of the conditional reflexes; and (2) the occurrence of symptoms months or years after the conflict on which they are based and to which they are related has been removed. The organism has thus, within itself, a potentiality for prodigious changes that are largely independent of external events.

Since my studies have been particularly concerned with pathological behavior, the "spontaneous" development or autokinesis that I have seen has to do especially with symptoms of maladjustment. The function of spontaneous restoration, however, could well be a force for therapy. Moreover, if, on the basis of a conflict, it is possible for the individual to elaborate a symptom and

a perversion of behavior, it is plausible to believe that from a single interview or from a single event, howsoever brief, there may ensue the most profound developments. This is a common experience in therapy and in life. The stimulation leaves a change in the nervous system and, on the basis of this trace of the excitation and without any repetition of the stimulation, the development proceeds gradually or swiftly through the months or years. We can now see, both from the laboratory and from experience, that the organism is in reality a dynamic, moving structure, carrying within itself some of the forces for its own evolution or dissolution.

VII. Summary

Research problems depend upon concepts and methods, as well as on the ability of the human observer. Pavlov's objective methodology introduced into physiology, for the first time, the chronic experiment instead of the acute experiment, and substituted for the isolated organ the intact healthy animal. Not only the voluntary muscular system but most of the autonomic nervous system and some of the endocrine glands have now been included in the framework of a methodology that allows us to study, at the highest possible level, the relationship of the individual to his changing environment and its stresses.

My investigation of experimental neuroses emphasizes that other important factors are present besides that of the difficult differentiation, which was discovered by Pavlov. First is the innate susceptibility of the individual to breakdown, and second are many details of the environmental stress situation, including especially the individuals concerned in the experimentation. The development of the neurotic breakdown may occur in both space and time; *i.e.*, it may spread to many physiological systems apparently not involved at first, and the spread may continue for a number of years after the original conflicting situation has been removed. Of particular interest is the involvement of the sexual system, including the paradoxical appearance of spontaneous sexual excitation with simultaneous sexual impotence.

This delayed spread, as well as other evidence from biology, leads us to the recognition of the importance of not only the reflex and immediate action of the environment on the individual (the aspect that has received most emphasis, due to the success of the method), but also of the dynamic forces within the individual that elaborate the traces of the stress and tend to erect upon them a neurotic structure (autokinesis). The study of retention by use of the general autonomic measures in comparison with the specific measures (emotional and conditional reflexes) gives us a new concept of inhibition as incomplete (perhaps negative excitation), rather than as a quiescent state. The reaction to the stress situation in a susceptible animal may thus follow a slow prolonged course transcending the original and temporal limits.

Two new principles are involved in the susceptibility to nervous breakdown: (1) the inherent conflict between the general emotional responses and the more perfectly adaptive responses (schizokinesis); and (2) the ability of the organism to form new patterns of behavior (both destructive and constructive), without external stimulation, through an inner development on the basis of the traces

of individual past experiences and the inner constitution of the organism (autokinesis).

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